PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H05K 9/00 | A1

(11) International Publication Number: **WO 99/43191**

(43) International Publication Date: 26 August 1999 (26.08.99)

(21) International Application Number: PCT/SE99/00227

(22) International Filing Date: 18 February 1999 (18.02.99)

(30) Priority Data:
9800488-0 19 February 1998 (19.02.98) SE

(71) Applicant *(for all designated States except US)*: NOLATO SILIKONTEKNIK AB [SE/SE]; Bergsmansvägen 4, S-694 91 Hallsberg (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: EKLIND, Jonas [SE/SE]; Hantverkargatan 23, S-694 31 Hallsberg (SE).

(74) Agent: AWAPATENT AB; P.O. Box 5117, S-200 71 Malmö (SE).

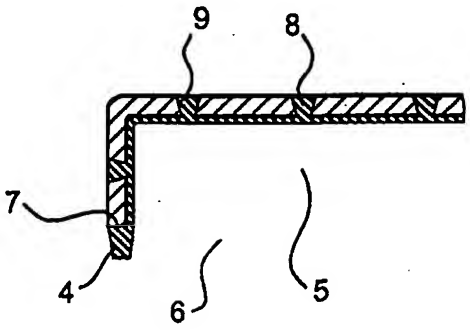
(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: HOUSING WITH SHIELDING PROPERTIES AND METHOD FOR MAKING IT

(57) Abstract

A housing for electromagnetic shielding comprises a body (2') without any essential electrical conductivity, which internally defines a space (5). The housing (2') further defines an opening (6) which is adapted to be directed towards a base. On a surface of the body (2') there is arranged a moulded polymer layer (3') with electrical conductivity, which forms an electromagnetic shielding enclosing the space (5). The invention also concerns the production of such a housing and use of a mouldable plastic material having electrical conductivity to form a surface-covering electromagnetic shielding of a space.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

HOUSING WITH SHIELDING PROPERTIES AND METHOD FOR MAKING IT

Field of the Invention

The present invention relates to a housing for electromagnetic shielding and a method of making such a housing according to the preamble to appended claims 1 and 9. Moreover, the invention concerns use of a mouldable polymer material having electrical conductivity.

Background Art

Electromagnetic shielding of electronic components is based on the principle of the Faraday cage, i.e. the electronics are shielded from electric fields in the surroundings, such as interference caused by radiofrequencies, by means of an electrically conductive casing. Thus the interference cannot penetrate the material of the conductive casing.

Electromagnetic shielding of electric and electronic components is necessary in, for instance, apparatus for transmitting and/or receiving radio signals. Especially in connection with portable apparatus, such as mobile telephones, great demands are placed on the achievement of efficient shielding without making the construction unnecessarily heavy and unwieldy.

Shielding devices of the type mentioned by way of introduction usually have a body which is not electrically conductive, for instance a plastic body, and an electrically conductive layer which is applied to the body. In one design, the layer is a conductive varnish. However, this layer is mechanically sensitive and does not withstand the process temperatures that may occur in subsequent process steps of manufacture, for instance, arranging a seal on the housing. Conductive varnishes further have environmental drawbacks, for instance related to solvents. There are also designs where metal films are applied to the body. Such a solution, however, is disadvantageous since it can be used only for certain

simple geometric shapes, and the production method is complicated. The body can also be coated with a metal by applying a very thin layer of metal to the surface of the body but this requires special equipment and is an expensive and complicated method. Moreover the metal layer is sensitive to mechanical action.

There are also housings which are made in one piece of a metal, but this type is expensive and requires in many cases a separate surface treatment, which results in a high production cost. Moreover a housing which is made entirely of metal will be relatively heavy on the one hand since the metal itself is heavy and, on the other hand, since the housing cannot be made of a material having a small thickness.

A shielding metal housing is disclosed in DE 43 19 965. This housing is adapted to shield electronic components located in the housing. The housing has an opening which is adapted to be directed towards a base. On the edges round the opening, an electrically conductive seal of silicone material is applied in a pasty initial state from a nozzle. This device suffers from the same drawbacks as those mentioned above in connection with devices which are entirely made of metal. Similar seals that have been dispensed or moulded to engaging edges are also known in connection with shielding housings which comprise a body and a conductive layer applied thereto.

Summary of the Invention

An object of the present invention is to provide a device for electromagnetic shielding which is improved in relation to the prior-art technique.

A specific object is to obviate or reduce the above drawbacks of the prior-art technique and provide a housing which at the same time has a good electromagnetic shielding capacity and a low weight. A special object is to provide a shielding device which has reduced sensiti-

vity to mechanical action and in particular withstands scratching.

A further object is to provide a new and improved method of production, which permits a lower production cost and satisfies greater demands in respect of a satisfactory working environment and natural environment.

According to the invention, these and other objects that will appear from the following description are now achieved by a housing and a method for producing the same, which are of the types stated by way of introduction and besides have the features stated in the characterising clauses of claims 1 and 9. The objects are also achieved by use according to claim 11.

Thus, the housing has a body without any essential electrical conductivity and a polymer layer moulded thereto and having electrical conductivity. The body defines a space and an opening which is adapted to be directed towards a base. The moulded polymer layer forms an electromagnetic shielding which encloses the space.

The invention is based on the new knowledge that by using an electrically conductive, moulded polymer layer as surface-covering material, it is possible to obtain a layer with properties such as good mouldability, good resistance to scratching and low density while at the same time an efficient electromagnetic shielding of a space can be achieved. A further advantage that can be achieved by means of a housing according to the invention is that it is inexpensive and easy to produce.

In connection with the invention, the term "enclose" means that the layer which is arranged on the surface of the body forms a screen or a casing round the space and is shaped according to the body such that the space is shielded in all directions except towards the opening.

In certain applications, it is possible to provide an acceptable shielding without the electrically conductive layer being extended over the entire body. The layer can have, for instance, a net- or lattice-shaped extent.

According to a preferred embodiment, however, the entire body is covered with the layer to guarantee a reliable shielding in a wide frequency range.

In a particularly preferred embodiment, the conductive polymer layer is a flexible or compressible layer of material. This guarantees a particularly long service life and insensitivity to mechanical action.

In a preferred embodiment, the housing comprises an electrically conductive seal arranged on edges round the opening. The seal serves on the one hand to seal against, for instance, dust and moisture and, on the other hand, to have an electromagnetically shielding effect.

The layer and the seal are preferably made of the same material and are in particular made in one piece. In this embodiment of the invention it is a great advantage that an electromagnetically shielding layer and an electromagnetically shielding seal can be made in a single, common step of production. As a result, great logistic advantages are achieved in the production, which guarantees a low production cost for the housing.

In a preferred embodiment, the layer is arranged on the inside of the body, which reduces the risk of the layer being mechanically affected. However, it is quite possible and, in certain geometric shapes of the body, it may be advantageous to arrange the layer on the outside.

According to a preferred embodiment of the invention, the layer and the body are interconnected by mechanical engagement. The solution involving mechanical engagement has, for instance, the advantage that the entire production process for applying the layer is carried out in a single operation, which reduces, inter alia, the production cost.

Brief Description of the Drawings

For the purpose of exemplification, the invention will now be described in more detail with reference to the accompanying drawings, which show currently preferred embodiments of the invention and in which

Fig. 1 is a perspective view of a housing according to a first embodiment of the present invention,

Fig. 2 is a partial view in cross-section along line II-II in Fig. 1,

Fig. 3 is a perspective view of a housing according to a second embodiment of the invention, and

Fig. 4 is a partial view in cross-section along line IV-IV in Fig. 3.

Description of Currently Preferred Embodiments of the Invention

Figs 1 and 2 illustrate a housing 1, which comprises a body 2 which internally defines a space 5, and an electrically conductive layer 3 arranged on the inside of the body 2. The body 2 also defines an opening 6, which is adapted to be directed towards a base (not shown), such as a printed circuit card, such that the housing 1 together with the base encloses the space 5 in all directions. The housing 1 further comprises an electrically conductive seal 4 arranged on edges 7 surrounding the opening 6, as is best seen in Fig. 2. The surfaces of the edges 7 are adapted to engage the base by the intermediary of the seal 4.

The electrically conductive layer 3 comprises a moulded flexible polymer and can specifically comprise a silicone rubber with silver added, but it goes without saying that there are many different materials that may be used. Silicone, however, has the advantage of being strong and temperature stable. Moreover, silicone is well suited as seal material.

The body 2 is not electrically conductive and is preferably made of plastic but may also be made of wood or paper. When the body 2 is made of plastic, it may have a wall thickness in the range of 0.3-0.5 mm and, in certain designs, have wall thicknesses down to 0.1 mm.

When making the housing 1, the layer 3 is moulded directly to the body 2. In the embodiment shown in Figs 1 and 2, first an adhesive layer, a primer, is applied to

the internal surface of the body 2 for chemical connection between the layer 3 and the body 2. Subsequently the body 2 is placed in a mould and then the layer 3 is moulded directly to the inside of the body 2 and is in this connection given the desired shape. A great advantage of the invention is that the design and thickness of the conductive layer 3 can be controlled very accurately by the appearance of the mould while at the same time the layer can be made in a single production step. Typical layer thicknesses are in the order of 0.1-0.5 mm, but thicker as well as thinner designs of the layer are possible. Moreover, the thickness of the layer can vary over the surface. After moulding the polymer is cured or cross-linked to form a coherent and flexible material.

Figs 3 and 4 show a second embodiment of a housing 1' where the layer 3' is connected to the body 2' by mechanical engagement, see Fig. 4. Otherwise this embodiment corresponds to the one described above. The body 2' has holes 9 of essentially conical longitudinal section. When moulding the layer 3', these holes 9 are filled with the electrically conductive polymer in liquid state and, after curing, form gripping means 8 attaching the layer 3' to the body 2'.

A housing according to any one of the embodiments described above is well suited, in cooperation with a base, such as a printed circuit card, to shield electronics in, for instance, a mobile telephone.

The invention is in no way limited to the embodiments described above, and several modifications are feasible within the scope of the inventive idea as expressed in the claims. For instance, the housing can be differently designed according to different applications. Moreover, an engagement between the polymer layer and the body can be effected by means of different designs.

CLAIMS

1. A housing for electromagnetic shielding, comprising

a body (2; 2') without any essential electrical conductivity, which internally defines a space (5) and which defines an opening (6) which is adapted to be directed towards a base; and

an electrically conductive layer (3; 3') which is arranged on a surface of the body (2; 2') and which forms an electromagnetic shielding enclosing the space (5), c h a r a c t e r i s e d in that the layer (3) comprises a moulded polymer layer having electrical conductivity.

2. A housing 1 as claimed in claim 1, wherein the body (2) forms an enclosure extending from the opening (6) and covering the space (5), the layer (3; 3') extending over the entire body (2; 2').

3. A housing as claimed in claim 1 or 2, wherein the polymer layer (3; 3') is flexible.

4. A housing as claimed in any one of claims 1-3, wherein the opening (6) is surrounded by edges (7) adapted to engage a base, an electrically conductive seal (4) being arranged on the edges (7).

5. A housing as claimed in claim 4, wherein the layer (3; 3') and the seal (4) are made in one piece.

6. A housing as claimed in any one of the preceding claims, wherein the layer (3; 3') is arranged on the inside of the body (2; 2').

7. A housing as claimed in any one of the preceding claims, wherein the layer (3') and the body (2') are interconnected by mechanical engagement.

8. A housing as claimed in any one of the preceding claims, wherein the layer (3; 3') comprises a silicone material with an admixture of an electrically conductive material.

9. A method of making a housing (1) for electromagnetic shielding, c h a r a c t e r i s e d by

moulding an electrically conductive polymer layer (3; 3') to a surface of a body (2; 2') without any essential electrical conductivity, with a view to forming an electromagnetic shielding which encloses a space (5) in the body (2; 2').

10. A method as claimed in claim 9, wherein the moulding of a layer to the body (2; 2') comprises the step of forming a shielding surface layer (3; 3') and a seal (4) round an opening (6) in the housing (1) in one piece in a common moulding operation.

11. Use of a mouldable polymer material having electrical conductivity to form a surface-covering electromagnetic shielding of a space.

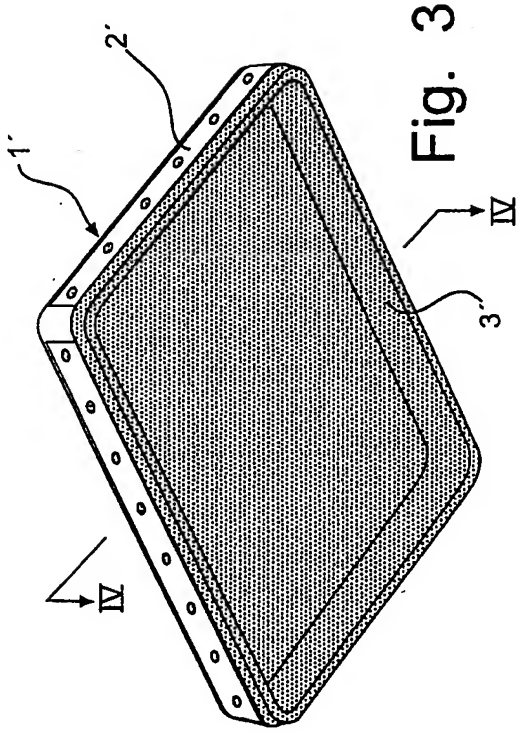


Fig. 3

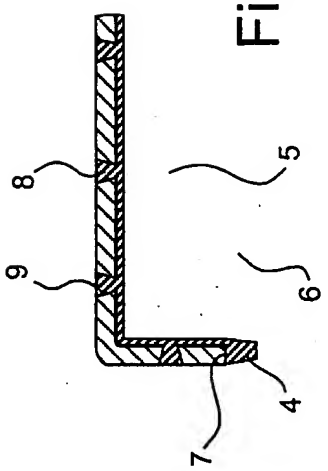


Fig. 4

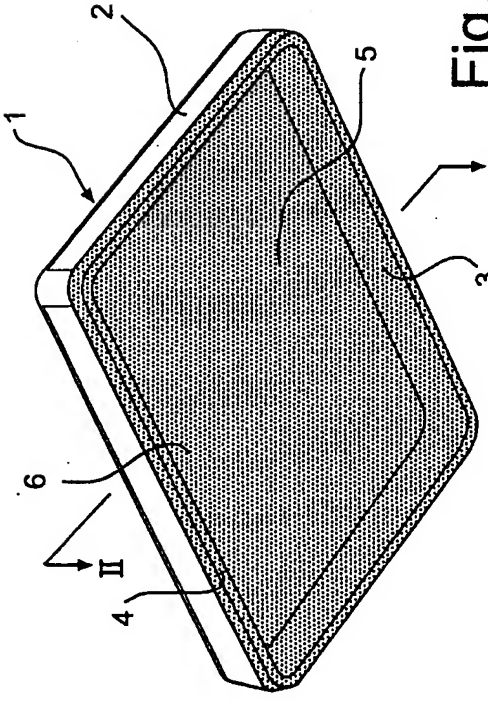


Fig. 1

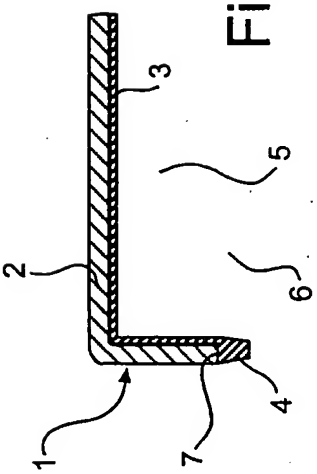


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00227

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05K 9/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2619655 A1 (P. MENNECIER), 24 February 1989 (24.02.89), see the whole document --	1-11
X	EP 0180383 A2 (ARONKASEI CO., LIMITED), 7 May 1986 (07.05.86), page 1, line 1 - line 11, figure 3 --	1-11
X	US 4585686 A (T. HASEGAWA ET AL.), 29 April 1986 (29.04.86), figure 1, abstract --	1-11
X	EP 0652696 A1 (AT & T CORP.), 10 May 1995 (10.05.95), figure 1, abstract --	1-11

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 1999	02 -08- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Joni Sayeler Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00227

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5397608 A (L.J. SOENS), 14 March 1995 (14.03.95), figures 1-2, claims 1-79	9-11
X	US 4664971 A (L.J. SOENS), 12 May 1987 (12.05.87), figures 1-2, claims 1-49	9-11
X	EP 0387419 A2 (TOYO INK MANUFACTURING CO., LTD.), 19 Sept 1990 (19.09.90), claims 1-9	9-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/07/99

International application No.
PCT/SE 99/00227

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2619655 A1	24/02/89	NONE	
EP 0180383 A2	07/05/86	NONE	
US 4585686 A	29/04/86	EP 0144150 A,B	12/06/85
		JP 1882896 C	10/11/94
		JP 6002925 B	12/01/94
		JP 60098604 A	01/06/85
		US 4762755 A	09/08/88
EP 0652696 A1	10/05/95	DE 69408782 D,T	02/07/98
		JP 2854254 B	03/02/99
		JP 7183681 A	21/07/95
		US 5416668 A	16/05/95
US 5397608 A	14/03/95	AU 562698 B	18/06/87
		AU 595562 B	05/04/90
		AU 595563 B	05/04/90
		AU 595564 B	05/04/90
		AU 6678786 A	16/04/87
		AU 6678886 A	16/04/87
		AU 6678986 A	16/04/87
		AU 9189882 A	07/07/83
		BE 895486 A	28/06/83
		CA 1194688 A	08/10/85
		CH 654970 A,B	14/03/86
		CH 659723 A,B	13/02/87
		CH 659724 A,B	13/02/87
		DE 3248658 A,C	07/07/83
		FR 2519180 A,B	01/07/83
		GB 2112796 A,B	27/07/83
		GB 2150936 A,B	10/07/85
		HK 90286 A	05/12/86
		HK 90386 A	05/12/86
		JP 1762798 C	28/05/93
		JP 1770434 C	30/06/93
		JP 2028621 B	25/06/90
		JP 58150203 A	06/09/83
		JP 63026783 B	31/05/88
		JP 63062107 A	18/03/88
		LU 84554 A	13/06/83
		NL 8105907 A	18/07/83
		SE 452280 B,C	23/11/87
		SE 8207260 A	01/07/83
		US 4664971 A	12/05/87

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/07/99

International application No.
PCT/SE 99/00227

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4664971 A	12/05/87	AU 562698 B	18/06/87
		AU 595562 B	05/04/90
		AU 595563 B	05/04/90
		AU 595564 B	05/04/90
		AU 6678786 A	16/04/87
		AU 6678886 A	16/04/87
		AU 6678986 A	16/04/87
		AU 9189882 A	07/07/83
		BE 895486 A	28/06/83
		CA 1194688 A	08/10/85
		CH 654970 A,B	14/03/86
		CH 659723 A,B	13/02/87
		CH 659724 A,B	13/02/87
		DE 3248658 A,C	07/07/83
		FR 2519180 A,B	01/07/83
		GB 2112796 A,B	27/07/83
		GB 2150936 A,B	10/07/85
		HK 90286 A	05/12/86
		HK 90386 A	05/12/86
		JP 1762798 C	28/05/93
		JP 1770434 C	30/06/93
		JP 2028621 B	25/06/90
		JP 58150203 A	06/09/83
		JP 63026783 B	31/05/88
		JP 63062107 A	18/03/88
		LU 84554 A	13/06/83
		NL 8105907 A	18/07/83
		SE 452280 B,C	23/11/87
		SE 8207260 A	01/07/83
		US 5397608 A	14/03/95
EP 0387419 A2	19/09/90	DE 68922986 D,T	19/10/95
		GB 2229186 A,B	19/09/90
		JP 2000074 C	08/12/95
		JP 2242844 A	27/09/90
		JP 7025988 B	22/03/95
		US 5248553 A	28/09/93